



*Growing Technology in the Mountain State*

July 3, 1997

David Rossi  
ONR Code 36  
Ballston Centre Tower One  
800 N. Quincy Street  
Arlington, Virginia 22217-5660

Subject: 4330:245:gts - Final Report for Grant No. N00014-95-1-1331

Dear Mr. Rossi:

The attached referenced report represents an accounting of the WVHTC Foundation's activities for the reporting period August 1, 1995 through February 28, 1997. The report covers the technical aspects of the Virtual Company program in accordance with the subject grant and OMB Circular A-110.

In the event you have questions or require further explanation of any of the report elements, please contact me at (304) 366-2577 ext. 279.

A handwritten signature in cursive script, reading 'Barbara Weaver'.

Barbara Weaver  
Vice President of Administration

**DTIC QUALITY INSPECTED 4**

enclosure: Final Technical Report

cc: Ms Francisca Ramos, ONR AGO  
Director, Naval Research Laboratory  
Defense Technical Information Center

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**West Virginia High Technology Consortium Foundation**

1000 Technology Drive ■ Suite 1000 ■ Fairmont, WV 26554 ■ Phone 304.366.2577 & 363.5482 ■ FAX 304.366.2699 & 363.5982

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# **VIRTUAL COMPANY/ DISTRIBUTED MANUFACTURING DEMONSTRATION PROJECT**

ONR GRANT NO: N00014-95-1-1331

## **Final Technical Report**

### **1. Introduction**

The following information summarizes the activities that took place under ONR Grant No. N00014-95-1-1331. Performance period of the Grant was August 1, 1995 until February 28, 1997. The total value for the award was \$2,400,000. Of that total, the National Oceanic and Atmospheric Administration, which falls under the Department of Commerce, provided \$900,000 to fund their Virtual Data Center and Legacy Data Rescue projects using VC/DM concepts and practices. Many of the activities discussed below have already been reported on in detail in earlier exclusive reports; the following merely synthesizes many of those activities.

### **2. Comprehensive Demonstration**

The comprehensive demonstration task was intended to focus on the effectiveness of the VC/DM concepts and procedures as a complete package or toolkit. Earlier demonstrations, by design, targeted selected elements of the overall package. By taking these concepts and procedures out of the controlled laboratory environment and applying them as an overall strategy to a full-scale manufacturing center, we will gain valuable insights would be revealed into the strengths and weaknesses in the VC/DM model. As weaknesses became evident necessary improvements would be accomplished. This task includes six subtasks:

1. Selection of Partner(s)
2. Information Infrastructure
3. Digital Interfaces
4. Training
5. Quality Assurance
6. Project Management

#### **2.1. Selection of Partners**

Three partners for this exercise included: POSITECH International, Electronic Warfare Associates (EWA), and the National Oceanic Atmospheric Administration (NOAA). While NOAA is not a manufacturing facility, they became aware of the VC concepts and were very interested in applying them to two of their projects. In order to be included in the demonstration, NOAA transferred \$900,000 to ONR to fund their Virtual Data Center and

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Legacy Data Rescue projects. These on-going projects are using a modified VC approach and are now under a separate award from NOAA. The POSITECH International project was exclusively a manufacturing oriented project while the EWA project was software oriented.

#### 2.1.1. POSITECH International

POSITECH International created an independent entity designating it the POSITECH Manufacturing Group. This group was formed for the purpose of applying VC/DM concepts and procedures to their daily business practices. PMG members were carefully selected to meet a series of related requirements to expand capabilities in the metalworking field. The diversity of their resources allows for just-in-time manufacturing, shared manufacturing, warehousing, rapid response delivery, and centralized quality assurance. In December 1995, PMG received national recognition through an article on small business enterprise networking, which was published in Business Week Enterprise.

The PMG part was divided into three phases. Phase I was expected to last 4 to 6 months and was aimed at completing the formation of the virtual company. Efforts included staff acquisition, training, and development of a marketing and operational plan. Phase II was scheduled for 8 to 10 months and involved cultivation of clients and obtaining a contract with the US Navy. Phase III was expected to last 8 to 12 months and was intended to make the new organization fully operational. Because the length of time required to perform all three phases would have extended beyond the period of performance for this award, only phases I and II were executed. As such, PMG was awarded a contract valued at \$125,000 for a period of February 1, 1996 through December 31, 1996.

Under the contract awarded to PMG, a prime objective was to secure a manufacturing contract with the US Navy. Their marketing approach revolved around contacting Navy personnel and submitting proposals in response to Navy solicitations. They made an averaged of around three to four bids/proposals per month for the duration of their contract. These efforts, unfortunately, were not successful; however, PMG did succeed in obtaining a contract with International Fuel Cells to build storage tanks and acquired licensing for its INEL Barrier Strip technology, both of which resulted out of their virtual company operations. The INEL Barrier Strip is being marketed to law enforcement agencies around the country. The device, when installed on the roadway, ends a high-speed pursuit by destroying the tires of the car in pursuit. There is strong interest in the device and several orders have already been received by PMG.

PMG also accomplished several infrastructure goals under the first two phases that positioned them to proceed more vigorously with full-scale VC/DM operations. Not forgetting that continuous improvement will always be a cornerstone of their operations, they successfully installed necessary staff support elements, completed several training initiatives geared toward expanding their manufacturing skill base, and implemented both a marketing plan and an operations plan. Additionally, they adapted bidding procedures that included virtual company team-building processes.

### 2.1.2. Electronic Warfare Associates

EWA formed a virtual company team consisting of NEW-BOLD Enterprises, DN American, Galaxy Global, and EWA for the purpose of applying VC/DM concepts and procedures to software development. They pursued a two phased approach consisting of program planning and requirement analysis for phase I and designing, coding, testing, evaluating, demonstrating, and documenting tasks for phase II. The product that resulted was a Requirements Traceability System (RTS) tool. The tool was designed for the Navy to be provided as GFE on future DoD projects. The RTS was also envisioned to be employed in software reuse libraries to evaluate cataloged source code.

EWA, the hub organization for this virtual company, was awarded a contract valued at \$399,901.00 with a performance period of 6 months to complete the project. DN American led the design effort making all final decisions involving design and communicating them to the other team members. NEWBOLD was responsible for writing the source code, testing was performed by EWA, and Galaxy provided documentation support. Because the companies all had a common infrastructure they were able to integrate seamlessly to provide a functioning software analysis tool complete with supporting documentation.

### 2.1.3. International Fuel Cells

The Foundation entered into relationship with International Fuel Cells of South Windsor, Connecticut with the purpose in mind to form a VC to manufacture fuel cells. The Department of Defense (DoD) was the intended customer. They were planning to purchase the fuel cells from the Department of Energy (DoE) who in turn would purchase them from the VC. Much effort went into this project going so far as DoE awarding a contract to the Foundation; however, because the DoD did not follow through with the expected funding, DoE was forced to terminate the contract for convenience.

### 2.1.4. OAO Robotics

During phase 3, the Foundation began discussions with the Robotics Division of OAO Corporation in Maryland. OAO is a privately held company whose core businesses are aerospace engineering, information technology, and robotics. They were interested forming a partnership whereby our VC would machine parts for their robots. OAO is presently building only one or two robots at a time so orders come in at a rate of ten or less items per order. The Foundation has a Memorandum of Understanding with OAO to work together when it comes time to go into full-scale production. This project has been valuable in testing the VC Model in that several administrative processes had to be developed and still being refined.

## 2.2. Information Infrastructure

A "Blue Ribbon Team" was commissioned to define the functional requirements and specifications for the Virtual Company's electronic information infrastructure. The team was formed from several companies to build a team of experts in all aspects of communications technology. The scope of their tasking was two-fold:

1. Evaluate the current proof of concept information system for the Distributive Manufacturing Virtual Company
2. Develop the functional requirements recommendations for the information system to support the Virtual Company Model

The team met for a period of five days (40 hours) and formulated a set of generic guidelines for developing any VC information system regardless of industry, size, or complexity. A key recommendation from the team was establishment of a VC Model Steering Committee with an Executive Committee and at least two working groups: an Information Systems Technical Working Group and a Business/Model Working Group. The Executive Committee would provide continuity and unity of vision to offset the fact that the VC Model is an evolving paradigm. The steering committee would possess both a broad perspective and the specialized expertise needed to manage the transition from the current conceptual model to a full functional operation. Some of the recommendations from this committee were implemented in this phase with most to be explored and implemented in phase IV.

### 2.3. Digital Interfaces

The Blue Ribbon Team also addressed technical issues and constraints of the current VC-LAN and made recommendations for improving the information management system. The system's environment and requirements have significantly evolved over time; however the information system resources and maintenance did not respond at the same rate. From the team's recommendations the VC-LAN was substantially upgraded when the Foundation moved into its new facility. A network administrator was installed full-time to maintain the LAN and prepare and execute a plan for the continual evolution of the network.

### 2.4. Training

Under phase III, two training tutorials were prepared to assist the small manufacturing firms to adopt VC practices. Both tutorials were reproduced on CD-ROMs and distributed.

The first tutorial was produced by the Foundation staff and dealt with the use and application of Lotus Notes (Notes). It covered bid processing, proposal preparation, and transmission of engineering drawings using Notes. In this case, technology overtook our efforts as Lotus significantly change their Notes software by greatly expanding its capabilities but also simplifying its use. As the hardware and training requirements for the original version of Notes was a significant cost, many of the shops did not want to make the investment. In fact, the Foundation even decommissioned the Notes Server. However, the new version requires a far less hardware and is far easier to use.

Tygart Technologies prepared the second tutorial, which addressed quality assurance. This effort was performed in conjunction with the quality assurance plan discussed below. The subject matter here is still very applicable to the VC and if used along with the QA plan can guide a small machine shop through the necessary steps to establishing a strong quality program. Tygart personnel supplemented this work by going to a number of shops and conducting limited on-site training.

## 2.5. Quality Assurance

Tygart Technologies, Inc. was tasked to prepare a VC/DM quality assurance plan. They prepared a comprehensive package that was generic in the sense that a typical small manufacturing facility could easily adapt it to their operations. The quality plan filled an important gap in the Virtual Company's ability to provide products and/or services that meet the customer's requirements and expectations. The plan was written in a way that would satisfy military (Mil-Q-9858), commercial (ANSI/ASQC Q 90 series), and International (ISO 9000) business segments. The system developed included the essential elements of a quality system that, with minor modification, could be utilized by a VC engaged in supplying a wide variety of products and services.

## 3. Virtual Company Model Improvement

Quest Contract Management Associates and Toothman & Rice accomplished much of the work in building and documenting the Virtual Company Model during phases I and II. The practices they developed, purchasing, subcontracting, property management, personnel, and other administrative processes, were fully implemented and have continue to function well. As in all business, one must be focused on continuous improvement of its processes in order to remain viable.

### 3.1. VC Purchasing, Subcontracting, and Management

During the course of phase III, Quest Contract Management Associates was absorbed into the Foundation. Benefits were immediately realized from this action. Prime award management within the Foundation was centralized and linkages established between prime award management, purchasing, and subcontract management. Centralizing the award management related processes also resulted in moving the Foundation away from predominantly sole sourcing awards to more competitive actions: this can be directly attributed to streamlined administrative activities and removal of communication barriers between the contracting experts and the program managers. By increasing competition, a more sustainable presence is ensured in the market place for the VC.

### 3.2. VC Accounting Practices, Procedures, and Systems

VC accounting practices and procedures continue to be an area receiving much attention. Personnel must diligently stay on top accounting and cost regulations and adapt the VC practices to these changes. The Foundation went through three separate audits in 1996. They were conducted by the Small Business Administration (SBA), the Department of Commerce (DoC), and Toothman and Rice. Except for some communication breakdowns between the SBA auditor and us, which now appear to be resolved, each audit went well and our accounting practices were deemed acceptable. Additionally, the DoC approved the Foundation's indirect cost structure.

#### **4. Technology Transition**

The purpose of this task was to provide an effective means of disseminating information about the VC/DM Model. The secondary objective was broadcasting the benefits of the Virtual Company to the world, i.e. using technology transition as the advertising arm of the Program. By educating potential customers on VC concepts, they can then evaluate their applicability to their environments.

In the area of training and education, we planned a three-prong approach to facilitate technology transition:

1. Advertise VC concepts at seminars, trade meetings, and other media
2. Provide information to other services and agencies to assist them in implementing VC practices
3. Continue the training started in Phases 1 and 2

We anticipated continuing our ongoing relationships with Fairmont State College (FSC) and the Marion County Adult and Community Education Center (MCACEC) as the vehicles to further develop and improve our training and education initiatives.

We believe the training and education area is a key component to the success of the virtual company. The Foundation along with ONR sponsored another series of the Federal Acquisition and Assistance Program for regional businesses. Twelve students graduated from the most recent class. This program has been very well received and we plan to conduct another series in phase IV; however, we intend to target more manufacturing oriented organizations for future classes.

Our Affiliate Services and Communications staff has been a successful beacon for spreading the VC/DM concepts. Monthly "Roundtable" meetings were conducted that brought business together to hear a variety of guest speakers to discuss topics pertinent to the affiliate members. These meetings also served as a forum to facilitate networking and formation of VC teams.

#### **5. Program Management**

Mr. L. Wade Linger was proposed to be the Program Manager/Principal Investigator for the VC/DM. His functions included:

- Day to day planning, execution, and control of the project
- Quality assurance including in house reviews
- Subcontractor utilization and management
- Cost and schedule control
- Development and delivery of the program management plan
- Responsiveness and reporting to ONR and the WVHTC Foundation's President

Supporting Mr. Linger was Dr. Maria Alexandra Toro responsible for the Technology Transition task, and Ms. Janet Rogers responsible for program administration. Mr. Linger was additionally assigned the role of project manager for the Comprehensive Demonstration task.

In February of 1996, Mr. Linger resigned his position of Vice President of Research and left the Foundation to start his own business. Mr. Clinton Arbogast was selected to replace Mr. Linger and assume the responsibilities of the Program Manager. Mr. Jim Estep replaced Mr. Linger as the Vice President of Research and assumed the role of Principal Investigator. The balance of the management staff remained in place for the duration of the project. The only change affecting the management of the program involved Quest. In November of 1996, Quest Contract Management Associates was dissolved as a corporation and absorbed into the Foundation staff. The effect of this was that it enabled centralized management of the Foundation's prime awards and subcontracts in toto.

Under this Grant, the Foundation issued 12 subcontracts valued at \$1,655,362.95. The National Oceanic and Atmospheric Administration (NOAA) to support development of their Virtual Data Center (VDC) and Legacy Data Rescue (LDR) projects funded three of the subcontracts. Seven awards valued at \$710,679.31, were sole sourced while five awards valued at \$944,683.64, were competed. The largest sole source award went to Marada Corp. and was done so at the urging of NOAA. It is the Foundation's desire to compete as many awards as possible. Our goal is to compete at least 70% of subcontract dollars. In this case, 57% of the subcontract dollars were competed. Had the Foundation been successful in persuading NOAA to allow it to compete the VDC work, we would have competed 73% of the available subcontract dollars. Awards to Tygart were not competed because no other entities in West Virginia were available or capable of performing the work required by the subcontract statement of work. The following table summarizes the Foundation's subcontract awards under this grant.

Subcontract Number	Subcontractor	Award Type	Value
WVHTC-F-VC95-1032	Electronic Warfare Associates	Competitive	\$399,901.00
WVHTCF-VCG-95-1031 (LDR)	Touchstone Research	Competitive	\$286,238.00
WVHTC-F-93-S95-1019 (VDC)	Marada Corp.	Sole Source	\$263,849.00
WVHTCF-BA96-1035 (Task 1)	West Virginia University	Sole Source	\$139,975.00
WVHTCF-VCG96-1041	Posi-Tech International	Competitive	\$125,000.00
WVHTCF-VCG96-1070	Tygart Technology	Sole Source	\$116,802.72
WVHTVCG-S96-1042	Loral	Competitive	\$99,743.64
WVHTC-F-S95-1033	Tygart Technology	Sole Source	\$89,077.59
WVHTC-F-C96-1043 (LDR)	Parascript, LLC	Sole Source	\$40,000.00
WVHTC-F-S96-1059	PTAC	Competitive	\$33,801.00
WVHTC-F-S96-1071	Quest Contract Management Assoc.	Sole Source	\$30,975.00
WVHTC-F-S96-1076	Tygart Technology	Sole Source	\$30,000.00



To ensure quality, the Foundation worked closely with in house staff support and virtual company team members to ensure objectives were clear and understood. The program manager and project managers met routinely to assess its efforts and ensure compliance with the program objectives. Additionally, program management reviews were held approximately every quarter to brief the ONR program manager. Technical reports were required annually; however, project updates were generally included with bimonthly reports submitted under grant number N00014-93-1-1194, which overlapped this grant.

The period of performance for this grant was August 1, 1995 until December 31, 1996. On December 19, 1996, the completion date was extended until February 28, 1997; however, a new schedule was not prepared to account for the additional time. Specifically, tasks awarded to Tygart, Loral, and West Virginia University were extended until the middle to end of January 1997. The tasks included the VC/DM Quality Assurance Plan, and the VC/DM Accounting practices, Procedures, and Systems.

## **6. Conclusion**

The Foundation realized many successes during this phase of the VC/DM project and a few lessons learned. Overall, the project is on line and proceeding forward. Phase IV will continue many of the initiatives started under Phase III such as the quality program, the training efforts, and the development of machine shop capabilities.